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ADVANCED WASTE TREATMENT PROJECT AT LEBANON, OHIO. NEW WATER FOR OLD

Federal Water Pollution Control Administration
Washington, D. C.

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ADVANCED WASTE TREATMENT RESEARCH
WATER RENOVATION PILOT PLANT
LEBANON FACILITY

NEW WATER FOR OLD

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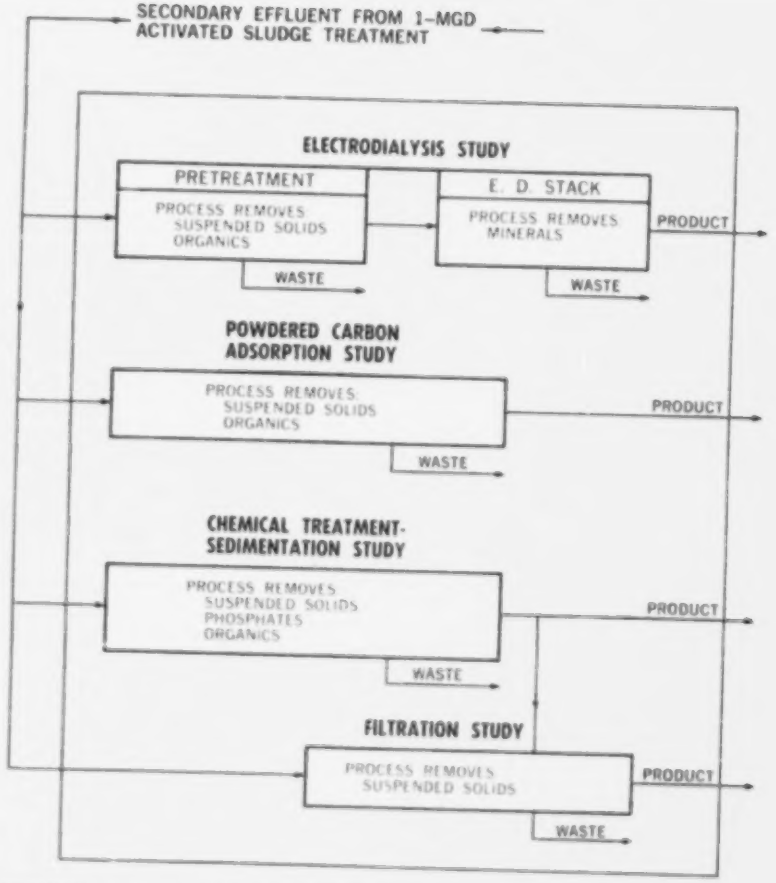


ADVANCED WASTE TREATMENT PROCESSES UNDER STUDY AT A.W.T.R. PILOT PLANT, LEBANON, OHIO

ADVANCED WASTE TREATMENT PROJECT AT LEBANON, OHIO

Details of illustrations in this document may be better studied on microfiche.

One of the great challenges facing this country today is that of finding efficient and economically feasible ways of making used water reusable.

It may not appear to be a glamorous goal but it is a necessary one. Our water use is increasing at a tremendous rate, thanks to our extraordinary growth in population, industry, and irrigated agriculture; higher standards of sanitation and increased urbanization; and ever-growing demands for fishing, swimming, boating, and other forms of water-oriented recreation.

At the same time, our rainfall remains relatively fixed. Unless we find new and better ways of renovating waste water, we shall soon be in deep trouble. At Lebanon, Ohio, the Federal Water Pollution Control Administration is conducting an experiment designed to help meet this challenge. Success in this effort would, in one step, increase available water supplies and abate the widespread health, economic, and esthetic damages caused by water pollution.

During the past 40 years, the population of the United States has doubled, and its industrial production has grown about five times. Yet, in all that time, few basic changes have been made in the treatment of our domestic, municipal, and industrial wastes. We still rely on a physical settling and screening process known as primary treatment, a microbiological process known as secondary treatment, dilution, and self-purification. These processes can no longer cope with the quantity and complexity of the organic and inorganic wastes that are discharged into our rivers, streams, lakes, and coastal waters.

By 1980 this Nation will need about 515 billion gallons of water every day. The most we can hope to have available as the result of engineering works is about 650 billion gallons a day. Since this water is spread unequally, it means that our more arid regions will soon be suffering from a shortage of clean water even more critical than that which they face now.

One obvious solution is to treat our water in such a way that each gallon can be reused more easily than now. Of the 150 gallons of water used daily by the average city dweller, 120 gallons return contaminated to the sewers—a flood of more than 15 billion gallons a day for the U. S. as a whole. If cleaned up, it would provide enough water for the daily needs of half our entire population. The flow of waste from industry and agriculture swells the total to approximately 260 billion gallons a day—equal to 70 percent of the Nation's present water needs.

The situation has been summarized in this way: "It now seems apparent that, one-time use of water has become a luxury we can no longer afford."

The reuse of water even now is nothing new. Many communities draw their water supplies from watercourses that contain waste discharges from cities upstream. Along the Mississippi and Missouri Rivers, it is a rare community indeed that enjoys water not previously used, at least in part, by a neighbor.

If we consider usage for agricultural, recreational, and other miscellaneous purposes, we must accept the fact that nearly all surface and underground waters have had some previous use. Going further, we can consider all water as reused, since rainfall is nothing more than surface water that has been evaporated and absorbed into cloud formations. The glass of water you drink today may well contain a drop that helped to float Noah's ark.

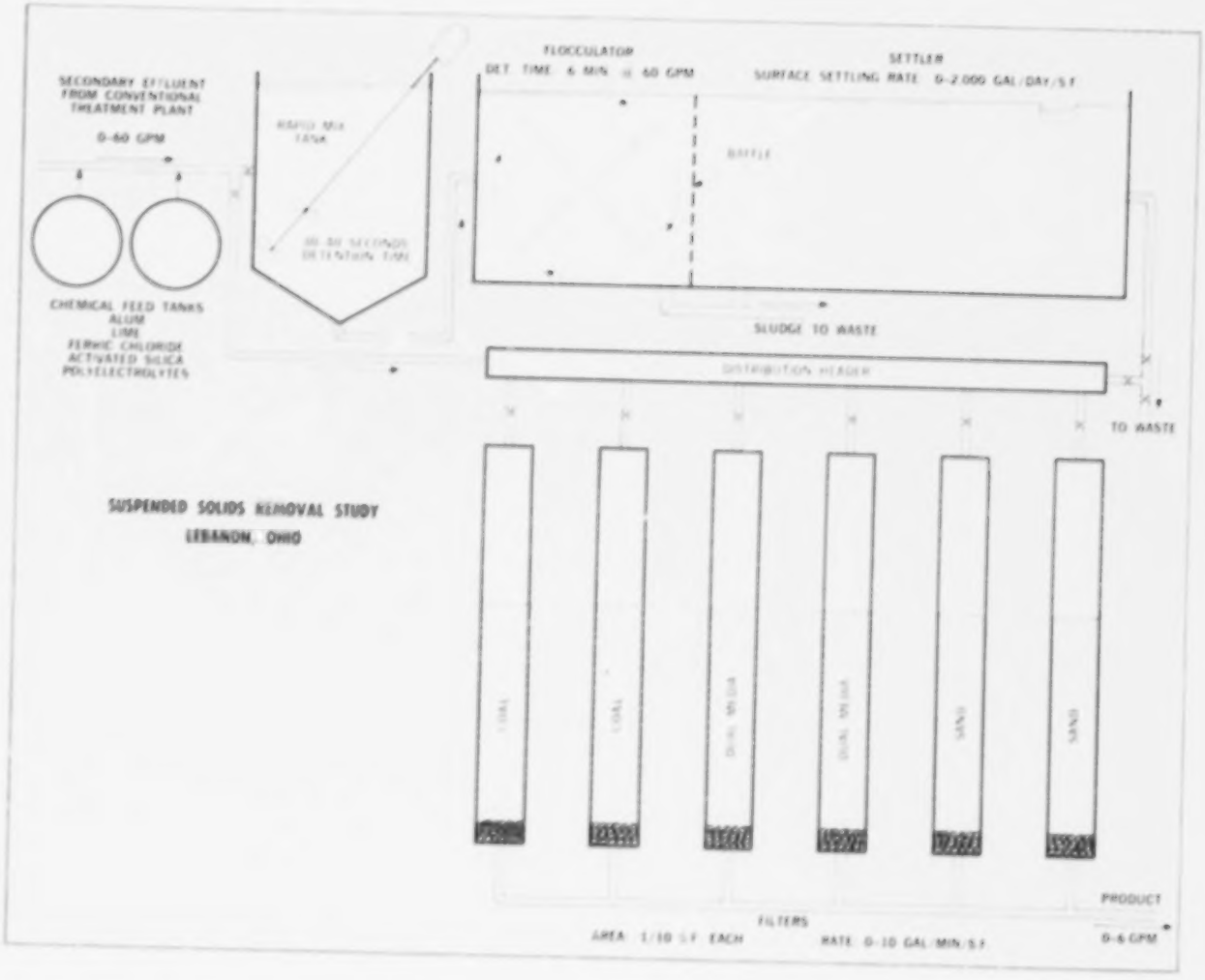
Thus, although the thought of deliberately reusing treated waste waters may be a startling concept to the average citizen, this practice, in varying degrees, is already widespread and is gaining momentum as our burgeoning population demands more and more water for more and more uses.

The problem of water renovation resolves itself into finding speedier and more effective processes of removing all types of wastes from water at a price that will be economically feasible.

This is the objective of the Advanced Waste Treatment research program launched in 1960. As a basic step in this operation, the Federal Water Pollution Control Administration entered into a cooperative agreement with the city of Lebanon, Ohio, on October 23, 1964, to build a pilot plant that would receive some of the effluent discharged from the city's waste treatment plant and use various combinations of processes to restore this effluent to a quality equal to that originally supplied from the domestic water source.

The Lebanon waste treatment plant provides conventional primary sedimentation and activated sludge secondary treatment. The waste effluent from this treatment normally contains 10 to 20 parts per million of suspended solids, about the same level of biochemically oxygen-demanding (BOD) materials, and perhaps 600-700 parts per million of dissolved salts.

The processes being evaluated and developed at Lebanon to remove the suspended solids, organic materials, and dissolved salts are the following: microscreening, filtration, chemical coagulation, powdered carbon adsorption, and electrodialysis. More detailed information on these processes follow.



SUSPENDED SOLIDS REMOVAL STUDY
LEBANON, OHIO

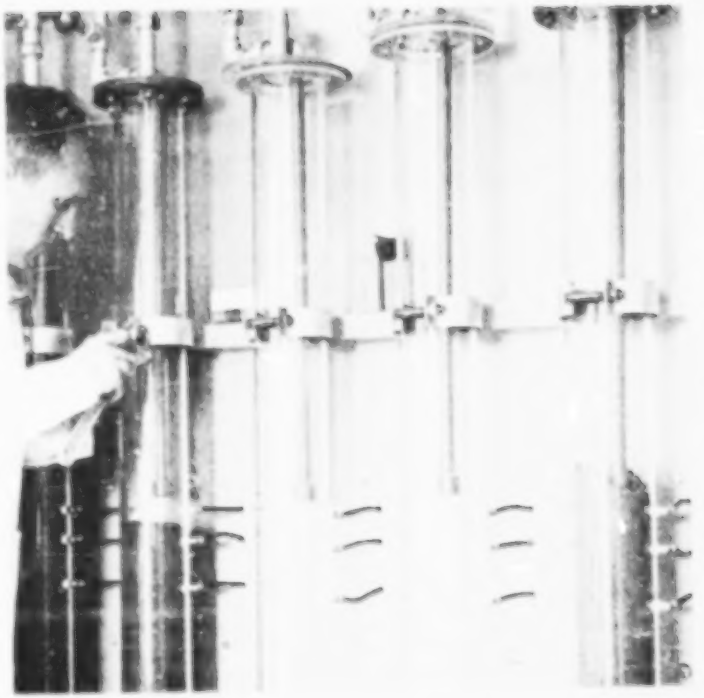
MICROSCREENING

Microscreening is a method of straining the suspended solids from a stream of water by passing the stream through a fine mesh screen. The rotating screen is continually cleaned by a system of sprays which remove the collected material.

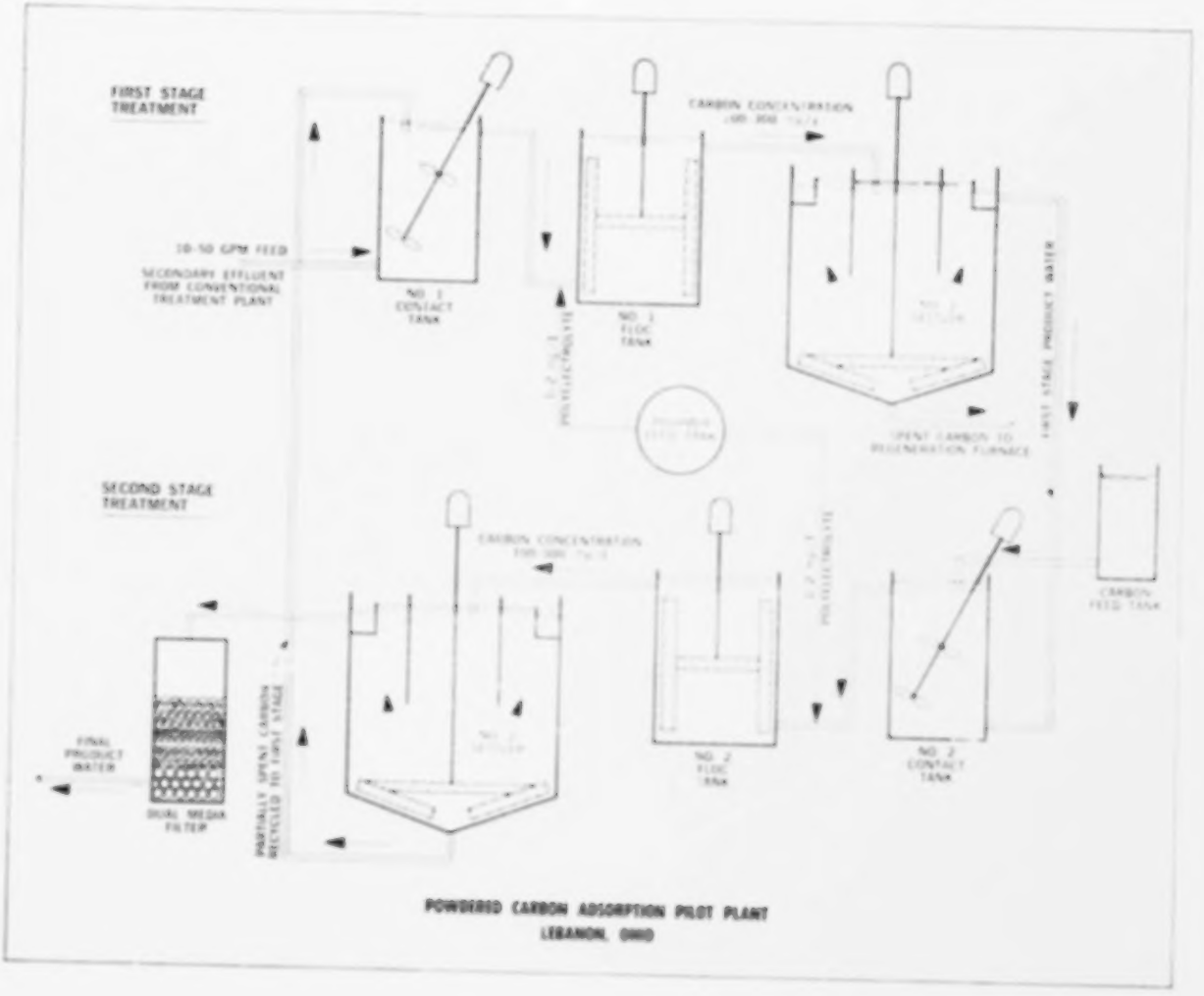
A microscreener is being studied at Lebanon for removal of suspended solids from secondary effluent. A fine mesh screen having 23 micron-sized openings has been found capable of removing up to 90 percent of the suspended matter. Other sizes of screen will be evaluated and operating characteristics will be established for this method of treatment.

COAGULATION-SEDIMENTATION-FILTRATION

Techniques to remove suspended solids and dissolved materials, which represent biochemical oxygen demand producing organics and algal nutrients in wastewaters, will be studied by chemically treating the secondary effluent to produce flocculant particles which can be removed from the water in sedimentation basins or by filtration through beds of sand, coal, anthracite or other appropriate filtration media. This study will seek to develop engineering design data for all aspects of removal, employing any single process or combination of processes which demonstrate promise under the realistic conditions encountered with the continuous flow treatment of secondary effluent.



Dual media filters used for suspended removing solids from effluent.



POWDERED CARBON ADSORPTION PILOT PLANT
LEBANON, OHIO

POWDERED CARBON ADSORPTION

A second treatment process being evaluated at Lebanon involves the use of powdered activated carbon for the removal of organic constituents. Whereas granular carbon adsorption involves passage of the waste liquid over fixed beds of granular carbon, powdered carbon adsorption is achieved by making a slurry with the powdered carbon in the waste stream and then using chemical coagulation and sedimentation to remove the powdered carbon particles from the water. The process is being studied in a 10 gallon-per-minute pilot unit, which is proving quite effective in removing not only organics but also suspended solids in the coagulation-sedimentation step. Although not included as part of the first phase of study, regeneration of the powdered carbon by heat will subsequently be studied. Overall economics of the process, not yet established, will depend largely on the effectiveness of the regeneration step.

These mixing and settling tanks contain powdered activated carbon used for removing organic constituents. Adsorption is achieved by making a slurry with the carbon in the waste stream, and then using chemical coagulation and sedimentation processes to remove the powdered carbon from the water.

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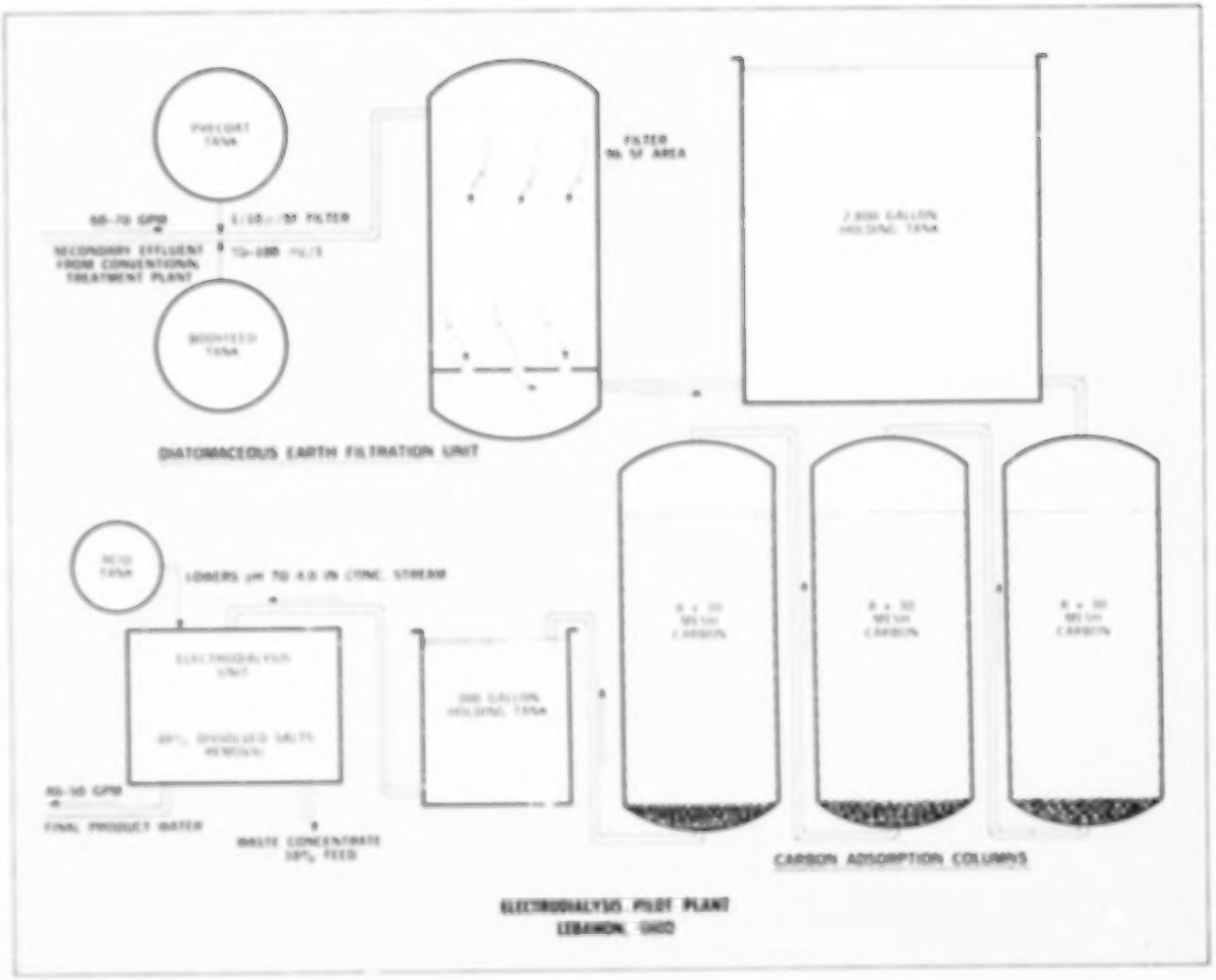
ELECTRODIALYSIS

Electrodialysis, a process which capitalizes on the attractive forces of opposite electrical charges, is a method for removing dissolved inorganic ions occurring as pollutants in wastewater. This process has shown considerable promise in laboratory-scaled equipment. It is being studied at Lebanon in a 50 gallon-per-minute stack operated under continuous flow conditions. The study will ascertain the suitability of this technique for treating the wastewaters under realistic operating conditions.

As a pretreatment for the wastewater to be fed into the electrodialysis stack, the stream first passes through a diatomaceous earth filter to remove suspended solids, and then through columns of granular activated carbon to remove dissolved organic materials. Both suspended solids and organics would foul the membranes of the electrodialysis stack if permitted to pass into the stack.

Control panel of 50-gallon per minute electrodialysis stack, operated under continuous flow conditions. This process removes dissolved inorganic ions occurring as pollutants in waste water.



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Municipal wastewater has not previously been treated by this process at this flow rate. However, laboratory studies have shown that concentration of per million parts of dissolved salts can be reduced by 40 to 50 percent. Preliminary results from the pilot unit confirm this removal. Cost of electrodialysis treatment for renovation of wastewater is expected to be about 15 cents per 1000 gallons at a 10-20 million gallons per day rate, exclusive of the diatomaceous earth filtration and carbon adsorption. The study here described will serve to confirm or modify this estimated cost.

The building that contains the pilot plant covers 1700 square feet. It was completed and process equipment installed during the spring and summer of 1965. All processes except filtration were in some stage of operation by August 1965, and have been in operation more or less continuously since that time.

The staff assigned to the plant consists of 11 sanitary engineers, technicians, and equipment mechanics. Annual operating budget for salaries and equipment amounts roughly to $110,000.

It is a small investment in comparison with the manifold benefits that will accrue from making enormous amounts of clean water available for industry, irrigation, municipalities, and recreation.

In its assigned function as the Nation's principal natural resource agency, the Department of the Interior bears a special obligation to assure that our expendable resources are conserved, that renewable resources are managed to produce optimum yields, and that all resources contribute their full measure to the progress, prosperity, and security of America, now and in the future.